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To Mr. F.J. Kee
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FIELD EXPERIENCE WITH DUAL SOURCE OIL/ELECTRIC HEATING SYSTEMS

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Forty-one homes throughout Ontario with oil-fired warm air heating systems have been retro-fitted with add-on electric plenum heaters. Field experience obtained during the installation and monitoring of these installations for the 1980-1981 and 1981-82 heating season has been summarized.

INTRODUCTION

This report discusses the initial plenum heater field installation and operating problems encountered during the 1980-1981 and 1981-1982 heating season. These dual source heating systems have been monitored to determine the amount of oil that can be displaced. Field visits were made twice a year to calibrate monitoring equipment and to take measurements. These measurements include: combustion efficiency, static pressure, air flow, current, voltage and oil samples.

OBSERVATIONS

Table 1 summarizes the observations on the add-on electrical heater and peripheral electrical system.

job	file	date	report no.
740612-502-011	814.7	January 26, 1983	82-482-K

TABLE 1

Location	Plenum Heater Size (kW) Old	New	Element Failure Old	New	Plenum Heater Component Failure	Mode Switch Position	Service Size (amps)	Service Entrance Component Failure	Max. Temp. (°F) Meter Base	Main Switch	Heating System Control - Load Limiter Installed
71-01	6	8.3	No	No	No	Auto	100	Main Switch Meter Base	190	-	No
02	10	8.3	Yes	No	- Relay	Electric	200	-	-	-	No
03	6	8.3	Yes	No	No	Auto	100	Main Switch	-	-	No
04	10	8.3	Yes	No	No	Auto	100	Meter Switch Meter Base	190	190	No
05	6	8.3	Yes	Yes	- Relay 8130B	Auto	100	-	-	-	No
06	6	8.3	Yes	Yes	- Relay - Thermostat	Auto	100	Meter Base	180	-	No
07	6	4.9	Yes	No	- Relay	Electric	60	Meter Base*	180	-	Yes
08	10	8.3	Yes	Yes	No	Auto	100	Meter Base*	180	-	No
09	10	8.3	Yes	Yes	No	Auto	100	Main Switch	*	-	No
10	6	8.3	No	No	No	Auto	100	-	-	-	No
11	6	8.3	No	No	No	Auto	125	-	-	-	No
12	6	8.3	No	No	No	Electric	100	-	-	-	No
13	10	8.3	No	No	No	Auto	200	-	-	-	No
14	10	8.3	No	No	No	Auto	100	-	-	-	No
15	6	4.9	No	No	No	Auto	60	-	-	-	Yes
16	10	8.3	No	No	No	Auto	200	-	-	-	No
17	10	8.3	No	No	No	Auto	100	-	-	-	No
18	6	4.9	Yes	No	No	Auto	100	-	-	-	No
19	6	8.3	No	No	No	Auto	100	-	-	-	No
20	6	8.3	No	No	No	Auto	100	Meter Base	180	-	No
21	10	8.3	No	No	No	Auto	200	-	-	-	No
22	6	4.9	No	No	No	Auto	60	Main Switch	-	190	Yes
23	6	8.3	Yes	Yes	Mode Switch Relay (Main)	Auto	100	Meter Base	180	-	No
24	6	8.3	No	No	Relay (8130)	Auto	100	Main Switch	-	190	No
25	10	8.3	No	No	No	Electric	100	-	-	-	No
26	10	8.3	Yes	No	No	Auto	100	-	-	-	No
27	10	8.3	Yes	No	No	Auto	100	-	-	-	No
28	6	8.3	Yes	No	No	Auto	100	-	-	-	No
29	10	8.3	Yes	No	Relay (8130) Mode Switch	Auto	100	Main Switch	-	190	No
30	6	4.9	Yes	No	No	Auto	60	-	-	-	Yes
31	6	8.3	No	No	No	Auto	100	Main Switch	-	180	No
32	6	8.3	Yes	No	No	Auto	100	Main Switch *	-	190	No
33	10	8.3	No	No	No	Electric	100	-	-	-	No
34	10	8.3	No	No	No	Auto	100	-	-	-	No
35	6	8.3	No	No	No	Auto	100	-	-	-	No
36	10	8.3	-	No	No	Auto	100	Meter Base	190	-	No
37	6	8.3	-	No	Mode Switch	Electric	100	Meter Base*	180	-	No
38	6	8.3	-	Yes	No	Auto	100	-	-	-	No
39	6	4.9	-	No	No	Auto	60	-	-	-	Yes
40	10	8.3	-	No	No	Auto	100	-	-	-	No
49	6	4.9	-	Yes	No	Auto	60	Main Switch	-	-	Yes

* Minor Overheating - Recommend Replacement after Final Inspection.

Notes:

1. The original heater elements installed were rated at 2 KW. They were replaced with 1.6 KW rated elements shortly after the heaters were installed in the field.
2. The mode switch changes the heating system operation from automatic to electric or oil only. It should be left in auto position at all times.
3. Temperature indicating tabs were installed in the meter base and main switch to monitor the maximum operating temperatures.
4. Plenum Heaters installed in homes with 60-amp services were wired from the dryer circuit. A load limiter was installed giving the dryer priority of operation.

Table 2 summarizes the observations made on the general heating system and customer reaction.

TABLE 2

Location	Air Distribution System Blower Motor Replacement: Existing	Replacement	Blower Motor Failure	Static Pressure (Inches of Water) Original	Replacement	Oil Furnace Combustion Efficiency 82-81	82-82	Oil Furnace Component Failure	Fuel Oil Condition	Moisture Problem	Customer Satisfaction With Plenum Heater	With Thermostats
71-01	1/3 hp	No	No	0.70	0.815	73	77	No	Dirty	No	No	No
02	1/3 hp	1/3 hp	Yes	0.70	0.70	71	72	No	Dirty	No	No	Yes
03	1/3 hp	1/3 hp	No	0.645	0.735	70	71	Blower Control	Dirty	No	No	No
04	1/2 hp	No	No	0.64	0.64	74	72	No	Clean	No	Yes	Yes
05	1/3 hp	No	No	0.55	0.52	N.A.	68	No	Clean	No	Yes	Yes
06	1/3 hp	No	Yes	0.49	0.54	55	70	No	Dirty	No	No	Yes
07	1/4 hp	1/3 hp	No	0.445	0.445	65	Furnace Failed	No	Clean	No	Yes	Yes
08	1/3 hp	No	No	0.725	0.700	63	71	No	Dirty	No	No	Yes
09	1/4 hp	1/3 hp	No	0.66	0.66	65	72	No	Clean	No	No	No
10	1/4 hp	1/3 hp	No	0.58	0.77	62	69	Fan Limit	Dirty	No	Yes	Yes
11	1/3 hp	No	No	0.46	0.60	78	80	No	Dirty	No	Yes	Yes
12	1/4 hp	1/3 hp	No	0.59	0.70	78	82	No	Dirty	No	Yes	Yes
13	1/3 hp	1/3 hp	Yes	0.49	0.94	68	72	No	Dirty	No	Yes	Yes
14	1/4 hp	1/2 hp	No	NA	0.80	74	71	No	Dirty	No	Yes	Yes
15	1/3 hp	No	No	0.65	0.65	69	74	No	Dirty	No	Yes	Yes
16	1/3 hp	No	No	0.41	0.44	69	72	No	Dirty	No	Yes	Yes
17	1/3 hp	1/3 hp	Yes	0.360	0.565	71	74	Fan Limit	Clean	No	Yes	Yes
18	1/2 hp	No	No	0.42	0.45	74	72	No	Dirty	No	No	Yes
19	1/3 hp	No	No	0.29	0.77	63	69	Furnace Control	Dirty	No	Yes	Yes
20	1/4 hp	1/3 hp	No	0.38	0.465	60	70	-	Dirty	No	Yes	Yes
21	1/2 hp	No	No	0.50	0.50	75	77	No	Dirty	No	Yes	Yes
22	1/3 hp	No	No	0.59	0.58	60	68	No	Clean	No	Yes	Yes
23	1/3 hp	No	No	0.495	0.435	70	75	Fan Limit	Dirty	No	Yes	Yes
24	1/3 hp	1/3 hp	1/3 hp	0.52	0.72	63	79	No	Clean	No	No	No
25	1/3 hp	No	No	0.545	0.345	68	74	No	Clean	No	Yes	Yes
26	1/4 hp	1/3 hp	No	0.43	0.51	78	75	Furnace Control	Dirty	No	Yes	Yes
27	1/3 hp	No	No	0.48	0.51	68	75	No	Dirty	No	Yes	Yes
28	1/3 hp	No	No	0.27	0.40	73	72	No	Dirty	Yes	Yes	Yes
29	1/3 hp	No	No	0.69	0.72	70	72	Stack Relay	Dirty	No	Yes	Yes
30	1/2 hp	No	No	0.40	0.40	78	82	No	Dirty	No	Yes	Yes
31	1/4 hp	1/3 hp	No	0.48	0.54	59	74	No	Dirty	No	Yes	Yes
32	1/3 hp	No	No	0.50	0.54	61	75	No	Clean	No	Yes	Yes
33	1/3 hp	No	No	0.76	0.53	62	70	No	Dirty	No	Yes	Yes
34	1/3 hp	No	No	0.49	0.58	65	72	No	Dirty	No	Yes	Yes
35	1/3 hp	1/2 hp	No	0.56	0.74	73	78	Fan Limit	Dirty	No	Yes	Yes
36	1/4 hp	No	No	NA	0.43	66	69	No	Clean	Yes	Yes	Yes
37	1/3 hp	No	No	NA	0.555	71	76	No	Clean	Yes	Yes	Yes
38	1/3 hp	No	No	NA	0.43	76	79	No	Clean	No	Yes	Yes
39	1/4 hp	No	No	NA	0.48	60	78	No	Clean	No	Yes	Yes
40	1/3 hp	No	No	NA	0.44	60	72	No	Dirty	No	Yes	Yes
41	1/4 hp	1/3 hp	No	NA	0.43	77	81	No	Dirty	No	Yes	Yes

Notes:

5. After the Plenum Heaters were installed, a static pressure test was performed with the original and replacement elements (inches of water).

6. A combustion efficiency measurement was made on the oil furnace under a typical operating cycle of 15 minutes (shown in Table 2 as percentage).

7. Customers were asked if they noticed any moisture problems after the Plenum Heaters were installed and operated.

SUMMARY

1. There was a large incidence of original elements failing. (26 out of 41 during the two heating seasons). This was due to a particular design of element which is no longer being used. The failures are not expected to happen with other designs.

2. The mode switch and sequence relay failed in 9 out of 41 Plenum Heaters throughout the test period. We think this was due to a poor quality batch of switches and relays.

3. Some of the participants tampered with the controls in order to save more oil.

4. Six out of twenty-three 100 amp meter bases and nine out of thirty main switches overheated. All the 125 amp service entrance equipment performed well.

5. Measured furnace combustion efficiency improved during the 1981-1982 heating season. This is probably due to Ontario Hydro insistance on proper maintenance of the heating systems at the end of the 1980-1981 heating season.

6. For no apparent cause, the combination fan limit control failed in some oil furnaces. In some instances they stayed off and in others they stayed on. (8 out of 41).

7. There was very low incidence of customer complaints with moisture problems. (3 out of 41).

8. There was high customer satisfaction with the Plenum Heater concept.

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